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INFORMATION REPORT

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SUBJECT Comments and Evaluations on two books on Welding and Alloys and four articles on Metals and Alloys

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1. Arc Welding Carbon and Alloy Constructional Steels by A S Ogiyevetskiy. Gosudarstvennoye Nauchno-Tekhnicheskoye Izdatel'stvo Mashinostroitel'noy Literatury. Moscow 1948. 384 pp

A. The book is divided into four main parts:

1) metallurgical basis of the arc-welding process (78pp)
2) arc welding carbon constructional steels (106pp)
3) arc welding alloy constructional steels (166pp)
4) residual stresses and heat treatment of weldments (22pp).

B. A competent first-class textbook that would be comprehensible to students and welders with only a slight knowledge of metallurgy. It is written from a practical viewpoint with few formulas and little theory not directly related to the actual arc-welding process.

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C. Ogiyevetskiy uses the term "constructional steels" in its broadest sense and includes all grades from carbon steels through heat-resistant austenitic steels. Tool and die steels, however, are not covered.

D. From internal evidence, it is suspected that Ogiyevetskiy had either been in the USA or had close connections with the USA.

1) Although there are few non-Soviet references (under 20%), he obviously is well acquainted not only with the regular USA literature but also with USA standards and methods.

2) The book is basically a Soviet text, but - particularly in the third part on alloy steels - there are complete and adequate discussions of USA grades and practices. (Many of these are undocumented.)

3) Furthermore, he shows a keen appreciation of USA ideas and tests that in 1948 had not gained wide acceptance in other countries. An example is the use of isothermal transformation diagrams as an aid in welding.

4) References to countries other than the USSR and USA are rare.

5) He persistently uses the term "columbium" and only rarely identifies it as niobium. The former term is of course generally used only in the USA.

E. References to shortages are few. In addition to the expected molybdenum and nickel, there is a rather surprising mention of vanadium as being both expensive and scarce.

2. Magnesium Alloys with Aluminum and Zinc by V I Mikheyeva. Izdatel'stvo Akademii Nauk SSSR. Moscow-Leningrad (1946) 190 pp with a supplement of 11 unnumbered pages devoted to photomicrographs

A. A monograph-type booklet dealing with part of a complete study of the aluminum-magnesium-zinc constitution diagram. This is an example of a complex ternary diagram that cannot be predicted from the relevant binary diagrams. Major attention is devoted to the magnesium-rich alloys and to a discussion of this diagram as illustrating Kurnakov's ideas on the chemical nature of intermetallic phases of variable composition.

B. An old-fashioned paper using old-fashioned methods, almost exclusively microstructure and thermal analysis. It is questionable whether such methods are adequate for highly complex diagrams such as this one. The general approach is similar to that used by Shamray for aluminum-magnesium-lithium alloys. This is to be expected since both Shamray and Mikheyeva were working with Kurnakov at the time both investigations were carried out.

F I Shamray: Ternary Aluminum-Magnesium-Lithium System. Part I. Method of Working with Lithium. Binary Systems. Izvestiya Akademii Nauk SSSR Otdeleniye Khimicheskikh Nauk (1947) no. 6, pp 605/616

F I Shamray: Ternary Aluminum-Magnesium-Lithium System. Part II. Phase Diagrams of Auxiliary Sections. Izvestiya Akademii Nauk SSSR Otdeleniye Khimicheskikh Nauk (1948) no. 1, pp 83/94

F I Shamray: Ternary Aluminum-Magnesium-Lithium System. Part III. Description of Ternary Al-Mg-Li System. Projection of Liquidus Surface, Isotherms at 400 C and 20 C and Process of Crystallization. Izvestiya Akademii Nauk SSSR Otdeleniye Khimicheskikh Nauk (1948) no. 3, pp 290/301

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C. Procedural details and experimental results are given in unusually great detail for a Soviet paper. That may have been one reason for the publication of this work as a monograph rather than in a magazine. Another may have been the accumulation of data during the war combined with difficulties in publishing papers of this type, although Mikheyeva did have at least one paper on this general topic published at that time.

D. In general, the results appear to agree with non-Soviet work for the simpler phases of solubility and the relatively uncomplicated portions of the constitution diagrams. When the diagrams become more complex, the agreement is not so good.

1) Al-Mg. The Metals Handbook diagram and the Kurnakov-Mikheyeva diagram are in approximate agreement at the two ends, but there are some differences in the complex middle section from about 35 to 60 atomic % Mg. Fink and Willey state, however, that they considered the diagram from 38 to 49% Mg had not been well established. It is notable that they do not refer to the Soviet work in the middle '30's and '40's.

W L Fink and L A Willey: Al-Mg Aluminum-Magnesium. Metals Handbook (1948) p 1163

2) Al-Zn. A diagram developed by Shamray is used. This shows the "possibility" of a peritectic at 443 C. Bochvar, Sviderskaya and Korbut at about the same time believed they had also proved the presence of this peritectic. Petrov and Badaeva, however, attributed the heat effect to an ordering process. On the other hand, Hume-Rothery and the Metals Handbook showed neither a peritectic nor ordering. The latter reference considers that heat effects at 443 C have not been explained convincingly.

E A Anderson: Al-Zn Aluminum-Zinc. Metals Handbook (1948) p 1167

A A Bochvar, Z A Sviderskaya and E K Korbut: On the Question of the Expansion of Some Alloys on Solidification. Izvestiya Akademii Nauk SSSR Otdeleniye Tekhnicheskikh Nauk (1947) no. 4, pp 409/417

W Hume-Rothery: Atomic Theory for Students of Metallurgy. The Institute of Metals (1947)

D A Petrov and T A Badaeva: Structure of Aluminum-Zinc Alloys and Structural Analogies in Other Alloys. Zhurnal Fizicheskoy Khimii 21 (1947) no. 7, pp 785/797

3) Mg-Zn. The magnesium-rich side is in agreement with the diagram generally accepted here. Otherwise there are two notable differences. Mikheyeva accepts the part of Takei's diagram that shows a peritectic at 410 C, whereas this does not appear in the Metals Handbook diagram. Secondly, Hess in the Metals Handbook believes that the data on the phase near to 50/54% Zn, which undergoes eutectoid transformation, are not sufficient to permit a revision of the diagram in this region. Mikheyeva considers her data adequate to describe the transformations in this area. (Hess cites two prewar Soviet references, but not the present booklet.) Savitskiy and Baron later reported that they believed part of the discrepancy as regards the different inter-metallic compounds reported in this diagram was related to differences in prior heat treatment.

J B Hess: Mg-Zn Magnesium-Zinc. Metals Handbook (1948) p 1227

E M Savitskiy and V V Baron: Constitution Diagram and Mechanical Properties of the System Mg-Zn. Doklady Akademii Nauk SSSR 64 (1949) pp 693/696

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4) Al-Mg-Zn. Apparently no work has been done on the magnesium-rich side of the ternary diagram since the Metals Handbook, which shows the liquidus, solidus and 100 C section based on prewar work and on one wartime British paper (reference 6). None of the previous Soviet work (some of which had already been published) is listed; on the other hand, Mikheyeva does not give the 1943 British work. While the broad general outlinesof the Metals Handbook diagrams are similar to Mikheyeva's diagrams, there are numerous discrepancies not only as to the limits of the phases but even as to the specific phases present. In part this may be the result of the different temperatures studied. There are other discrepancies, however, that cannot be explained by this means. On the other hand, Fink and Willey are in agreement with Mikheyeva that the only ternary intermetallic phase (called gamma by Fink and Willey and T by Mikheyeva) is not adequately described by the usual designation $Mg_3Zn_3Al_2$.

W L Fink and L A Willey: Al-Mg-Zn Aluminum-Magnesium-Zinc. Metals Handbook (1948) p 1247

E. This booklet is another proof of the great attention paid to constitution diagrams in the USSR. Nor has the interest decreased, as evidenced by the 1952 Conference on the Theory of Metallic Alloys where the Presidium of the Academy of Sciences of the USSR acknowledged the need for appreciably strengthening research, particularly the investigation and construction of constitution diagrams. Although Mikheyeva stated that her work was part of the program being carried out at the Physico-Chemical Analytical Institute to assist in the development of Soviet production of new magnesium-base alloys, Afanas'ev's 1954 data sheet gives no indication that this search has been successful.

Ya Ye Afanas'ev: Magnesium Alloys. "Vestnik Mashinostroyeniya" (1954) no. 2, pp 39/42

On the Results of the Conference on the Theory of Metallic Alloys. Vestnik Akademii Nauk SSSR 22 (1952) no. 11, p 116

F. The lapse between the appearance of the 1943 British paper mentioned under D. 4 and the present booklet, which does not mention it, is similar to that noted in the review of Mirgalovskaya. Such delays in receipt of the results of foreign investigations would certainly be likely to lead to unnecessary work.

M S Mirgalovskaya: Q Phase in the Aluminum-Copper-Magnesium System. Doklady Akademii Nauk SSSR 77 (1951) no. 2, pp 289/292

G. Only 30 of the 77 references are Soviet.

3. Change in Mechanical Properties of Metals under Hydrostatic Pressure by S I Ratner. Zhurnal Tekhnicheskoy Fiziki 19 (1949) pp 408/411

A. Experimental. The effect of high hydrostatic pressures on the mechanical properties of various materials (copper, magnesium, beryllium copper, two magnesium alloys MA2 and MA3, a cast aluminum alloy AL5 and an aluminum-copper-magnesium-zinc alloy) was determined. In some cases the entire stress-strain curve was obtained.

1) The normal stress in the shear plane has an appreciable influence on the entire process of plastic deformation.

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2) Hydrostatic pressure changes not only the fracture strength and limiting plasticity but also the resistance to plastic deformation.

3) The specific effect of hydrostatic pressure on the behavior of metals in the plastic region is determined in the first place by their structure.

B. The work is similar to some of the research Bridgman has done over the years. As with Bridgman's studies, there is no evident immediate practical application although the information might eventually be used in fields such as the hot working of metals.

C. Ratner's equipment apparently is not capable of applying as high pressures as have been obtained by Bridgman. The highest pressure used by Ratner was 2200 atmospheres, or about 32,000 psi; whereas Bridgman has regularly worked with pressures up to 180,000 psi and has occasionally reached 300,000 psi - or roughly ten times as high a pressure as Ratner's maximum.

P W Bridgman: Properties of Materials Under Extreme Pressures Machine Design 23 (1951) no. 7, pp 210, 212, 215/216, 220

D. Point A.3. above is not clear nor is it developed by Ratner. There is no obvious relation between the observed differences among the materials tested and their presumed structures. Perhaps this would be more evident to a Soviet reader who had seen Ratner's previous paper on the effect of cold work on the stress-strain diagram of various materials, as Ratner says the results of the two investigations are in good agreement in this respect.

E. Strangely enough there are no references cited, although Bridgman is referred to by name in the text, and Ratner refers to some previous work he has done.

4. Relation between the Mechanical Properties of Porous Metals and Their Porosity, and the Limiting Properties of Porous Powder-Metallurgy Materials. Doklady Akademii Nauk SSSR 67 (1949) no. 5, pp 831/834

A. A recapitulation and further development of Bal'shin's theory. A log-log plot shows a linear relation between porosity and compacting pressure and mechanical properties of unsintered electrolytic copper. A similar relation (but with different slopes) holds for sintered copper not only for strength and modulus of elasticity but also for plasticity. These results are in agreement with Bal'shin's of porosity and as-cast properties show a good correlation with experimental data obtained on sintered porous materials.

B. An interesting paper that would seem to answer the often-raised question as to whether the effect of pores consists merely in the reduction of the stress-bearing area, or whether there is an additional notch effect. On the basis of this work, the answer would seem to be that there is no notch effect, perhaps because the stress concentration caused by an individual hole is relieved by the surrounding holes.

C. The data presented indicate a fairly clean-cut relation for both sintered and unsintered material. There are certain questions, however:

1) The reliability of mechanical-property determinations on unsintered compacts is doubtful.

2) All these data were obtained on copper. There is no indication as to the effect of composition.

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3) It is not clear as to whether the only effect of changes in compacting and sintering conditions would be to alter porosity.

D. The good agreement with the results of other experimenters in respect to limiting strength indicates the general validity of this concept.

E. Half of the eight references are non-Soviet.

5. Investigation of the Action of Lubrication during Small-Scale Process of Deep Drawing by S Ya Veyler, L A Shreyner and P A Rebinder. Doklady Akademii Nauk SSSR 73 (1950) no. 3, pp 511/513

A. Details of test suitable for plant-control purposes as well as for laboratory investigation of the effect of lubricating or cooling mediums on deep drawing. A limited number of results indicates that the lubricant affects the effective drawing force and the nominal coefficient of friction.

B. Interesting but unconvincing in view of the lack of any correlation with practical results obtained in plants. Laboratory tests to determine the effect of various factors on deep-drawing characteristics are relatively simple to set up but notoriously difficult to tie in with shop experience.

6. Investigation of the Ordering Process in the Alloy Cu_3Au by Measurement of Electrical Fluctuations by E Ya Pumper. Doklady Akademii Nauk SSSR 72 (1950) no. 6, pp 1033/1036

A. Experimental. Previous work had indicated that changes in the level of emf fluctuations could be used to measure microscopic processes taking place in conductors. Tests on the ordering of Cu_3Au proved this type of test was effective here too, and would permit a more detailed study of the kinetics of the process of ordering than does X-ray diffraction.

B. There is nothing new in the implications of the data. As a matter of fact, this work was suggested by Komar, who also furnished the material - presumably that used in his research.

A P Komar: Long-Range Order in Alloys of the Au-Cu System and the Electrical Resistivity of These Alloys. Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki 17 (1947) no. 8, pp 753/756

C. The only novelty appears to be the experimental method. Unfortunately, details of procedure are not given and cannot be surmised accurately. They were probably described in his 1949 Izvestiya paper where, according to the Metals Review abstract, studies were made in connection with the electrical resistance of various materials and in connection with fluctuations in electron tubes containing tungsten cathodes. Electrical resistivity by itself has, of course, long been used to study ordering; Komar, for example, used this type of test.

E Ya Pumper: Use of Measurement of Electric Fluctuations as a Method for Investigating Processes in Metals. Izvestiya Akademii Nauk SSSR 13 (1949) pp 596/614

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